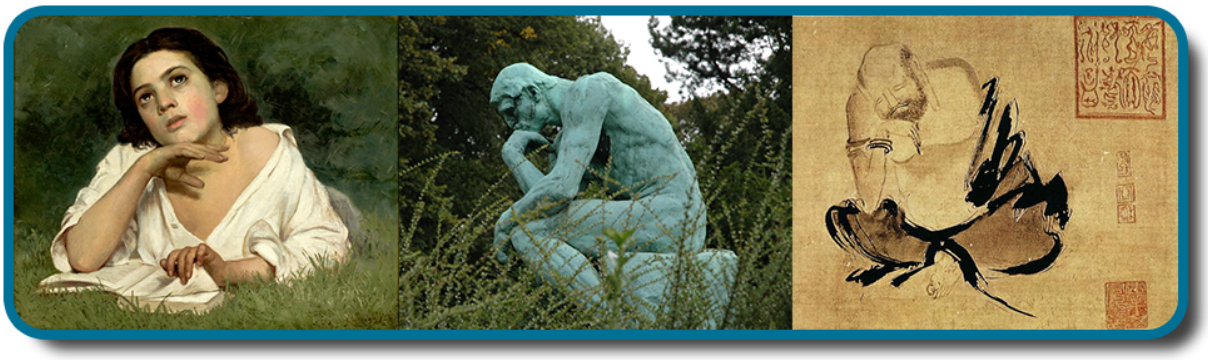
9.0 Introduction to Thinking and Intelligence

class="introduction"

Thinking is an important part of our human experience, and one that has captivated people for centuries. Today, it is one area of psychological study. The 19th-century *Girl with a Book* by José Ferraz de Almeida Júnior, the 20th-century sculpture *The Thinker* by August Rodin, and Shi Ke's 10th-century painting *Huike Thinking* all reflect the fascination with the process of

human thought. (credit "middle": modification of work by Jason Rogers; credit "right": modification of work by Tang Zu-Ming)



Cognitive psychologists study intelligence. What is intelligence, and how does it vary from person to person? Are "street smarts" a kind of intelligence, and if so, how do they relate to other types of intelligence? What does an IQ test really measure? These questions and more will be explored in this chapter as you study thinking and intelligence.

In other chapters, we discussed the cognitive processes of perception, learning, and memory. In this chapter, we will focus on high-level cognitive processes. As a part of this discussion, we will consider thinking and briefly explore the development and use of language. We will also discuss problem solving and creativity before ending with a discussion of how intelligence is measured and how our biology and environments interact to affect

intelligence. After finishing this chapter, you will have a greater appreciation of the higher-level cognitive processes that contribute to our distinctiveness as a species.

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9.1 What Is Cognition?
By the end of this section, you will be able to:

- Describe cognition
- Distinguish concepts and prototypes
- Explain the difference between natural and artificial concepts

Imagine all of your thoughts as if they were physical entities, swirling rapidly inside your mind. How is it possible that the brain is able to move from one thought to the next in an organized, orderly fashion? The brain is endlessly perceiving, processing, planning, organizing, and remembering—it is always active. Yet, you don't notice most of your brain's activity as you move throughout your daily routine. This is only one facet of the complex processes involved in cognition. Simply put, **cognition** is thinking, and it encompasses the processes associated with perception, knowledge, problem solving, judgment, language, and memory. Scientists who study cognition are searching for ways to understand how we integrate, organize, and utilize our conscious cognitive experiences without being aware of all of the unconscious work that our brains are doing (for example, Kahneman, 2011).

COGNITION

Upon waking each morning, you begin thinking—contemplating the tasks that you must complete that day. In what order should you run your errands? Should you go to the bank, the cleaners, or the grocery store first? Can you get these things done before you head to class or will they need to wait until school is done? These thoughts are one example of cognition at work. Exceptionally complex, cognition is an essential feature of human consciousness, yet not all aspects of cognition are consciously experienced.

Cognitive psychology is the field of psychology dedicated to examining how people think. It attempts to explain how and why we think the way we do by studying the interactions among human thinking, emotion, creativity, language, and problem solving, in addition to other cognitive processes. Cognitive psychologists strive to determine and measure different types of intelligence, why some people are better at problem solving than others, and

how emotional intelligence affects success in the workplace, among countless other topics. They also sometimes focus on how we organize thoughts and information gathered from our environments into meaningful categories of thought, which will be discussed later.

SCHEMATA

A **schema** is a mental construct consisting of a cluster or collection of related concepts (Bartlett, 1932). There are many different types of schemata, and they all have one thing in common: schemata are a method of organizing information that allows the brain to work more efficiently. When a schema is activated, the brain makes immediate assumptions about the person or object being observed.

There are several types of schemata. A **role schema** makes assumptions about how individuals in certain roles will behave (Callero, 1994). For example, imagine you meet someone who introduces himself as a firefighter. When this happens, your brain automatically activates the "firefighter schema" and begins making assumptions that this person is brave, selfless, and community-oriented. Despite not knowing this person, already you have unknowingly made judgments about him. Schemata also help you fill in gaps in the information you receive from the world around you. While schemata allow for more efficient information processing, there can be problems with schemata, regardless of whether they are accurate: Perhaps this particular firefighter is not brave, he just works as a firefighter to pay the bills while studying to become a children's librarian.

An **event schema**, also known as a **cognitive script**, is a set of behaviors that can feel like a routine. Think about what you do when you walk into an elevator . First, the doors open and you wait to let exiting passengers leave the elevator car. Then, you step into the elevator and turn around to face the doors, looking for the correct button to push. You never face the back of the elevator, do you? And when you're riding in a crowded elevator and you can't face the front, it feels uncomfortable, doesn't it? Interestingly, event schemata can vary widely among different cultures and countries. For example, while it is quite common for people to greet one another with a handshake in the United States, in Tibet, you greet someone by sticking

your tongue out at them, and in Belize, you bump fists (Cairns Regional Council, n.d.)

Remember the elevator? It feels almost impossible to walk in and *not* face the door. Our powerful event schema dictates our behavior in the elevator, and it is no different with our phones. Current research suggests that it is the habit, or event schema, of checking our phones in many different situations that makes refraining from checking them while driving especially difficult (Bayer & Campbell, 2012). Because texting and driving has become a dangerous epidemic in recent years, psychologists are looking at ways to help people interrupt the "phone schema" while driving. Event schemata like these are the reason why many habits are difficult to break once they have been acquired. As we continue to examine thinking, keep in mind how powerful the forces of concepts and schemata are to our understanding of the world.

Summary

In this section, you were introduced to cognitive psychology, which is the study of cognition, or the brain's ability to think, perceive, plan, analyze, and remember. Concepts and their corresponding prototypes help us quickly organize our thinking by creating categories into which we can sort new information. We also develop schemata, which are clusters of related concepts. Some schemata involve routines of thought and behavior, and these help us function properly in various situations without having to "think twice" about them. Schemata show up in social situations and routines of daily behavior.

Review Questions

Exercise:

Problem:

Cognitive psychology is the branch of psychology that focuses on the study of _____.

A. human development
B. human thinking
C. human behavior
D. human society

Solution:

B

Exercise:

Problem:

Which of the following is an example of a prototype for the concept of leadership on an athletic team?

A. the equipment manager
B. the star player
C. the head coach
D. the scorekeeper

Solution:

B

Exercise:

Problem:

Which of the following is an example of an artificial concept?

A. mammals
B. a triangle’s area
C. gemstones
D. teachers

Solution:

B

Exercise:

Problem: An event schema is also known as a cognitive _____.

A. stereotype
B. concept
C. script
D. prototype

Solution:

C

Critical Thinking Questions

Exercise:

Problem:

Describe a social schema that you would notice at a sporting event.

Solution:

Answers will vary. When attending a basketball game, it is typical to support your team by wearing the team colors and sitting behind their bench.

Exercise:

Problem:

Explain why event schemata have so much power over human behavior.

Solution:

> Event schemata are rooted in the social fabric of our communities. We expect people to behave in certain ways in certain types of situations, and we hold ourselves to the same social standards. It is uncomfortable to go against an event schema—it feels almost like we are breaking the rules.

Glossary

artificial concept
: concept that is defined by a very specific set of characteristics

cognition
: thinking, including perception, learning, problem solving, judgment, and memory

cognitive psychology
: field of psychology dedicated to studying every aspect of how people think

concept
: category or grouping of linguistic information, objects, ideas, or life experiences

cognitive script
: set of behaviors that are performed the same way each time; also referred to as an event schema

event schema
: set of behaviors that are performed the same way each time; also referred to as a cognitive script

natural concept
: mental groupings that are created “naturally” through your experiences

prototype
: best representation of a concept

role schema
: set of expectations that define the behaviors of a person occupying a particular role

schema
: (plural = schemata) mental construct consisting of a cluster or collection of related concepts

9.2 Language
By the end of this section, you will be able to:

- Define language and demonstrate familiarity with the components of language
- Understand how the use of language develops
- Explain the relationship between language and thinking

Language is a communication system that involves using words and systematic rules to organize those words to transmit information from one individual to another. While language is a form of communication, not all communication is language. Many species communicate with one another through their postures, movements, odors, or vocalizations. This communication is crucial for species that need to interact and develop social relationships with their conspecifics. However, many people have asserted that it is language that makes humans unique among all of the animal species (Corballis & Suddendorf, 2007; Tomasello & Rakoczy, 2003). This section will focus on what distinguishes language as a special form of communication, how the use of language develops, and how language affects the way we think.

COMPONENTS OF LANGUAGE

Language, be it spoken, signed, or written, has specific components: a lexicon and grammar. **Lexicon** refers to the words of a given language. Thus, lexicon is a language's vocabulary. **Grammar** refers to the set of rules that are used to convey meaning through the use of the lexicon (Fernández & Cairns, 2011). For instance, English grammar dictates that most verbs receive an "-ed" at the end to indicate past tense.

Words are formed by combining the various phonemes that make up the language. A **phoneme** (e.g., the sounds "ah" vs. "eh") is a basic sound unit of a given language, and different languages have different sets of phonemes. Phonemes are combined to form **morphemes**, which are the smallest units of language that convey some type of meaning (e.g., "I" is both a phoneme and a morpheme). We use semantics and syntax to construct language. Semantics and syntax are part of a language's grammar.

Semantics refers to the process by which we derive meaning from morphemes and words. **Syntax** refers to the way words are organized into sentences (Chomsky, 1965; Fernández & Cairns, 2011).

We apply the rules of grammar to organize the lexicon in novel and creative ways, which allow us to communicate information about both concrete and abstract concepts. We can talk about our immediate and observable surroundings as well as the surface of unseen planets. We can share our innermost thoughts, our plans for the future, and debate the value of a college education. We can provide detailed instructions for cooking a meal, fixing a car, or building a fire. The flexibility that language provides to relay vastly different types of information is a property that makes language so distinct as a mode of communication among humans.

LANGUAGE DEVELOPMENT

Given the remarkable complexity of a language, one might expect that mastering a language would be an especially arduous task; indeed, for those of us trying to learn a second language as adults, this might seem to be true. However, young children master language very quickly with relative ease. B. F. Skinner (1957) proposed that language is learned through reinforcement. Noam Chomsky (1965) criticized this behaviorist approach, asserting instead that the mechanisms underlying language acquisition are biologically determined. The use of language develops in the absence of formal instruction and appears to follow a very similar pattern in children from vastly different cultures and backgrounds. It would seem, therefore, that we are born with a biological predisposition to acquire a language (Chomsky, 1965; Fernández & Cairns, 2011). Moreover, it appears that there is a critical period for language acquisition, such that this proficiency at acquiring language is maximal early in life; generally, as people age, the ease with which they acquire and master new languages diminishes (Johnson & Newport, 1989; Lenneberg, 1967; Singleton, 1995).

Children begin to learn about language from a very early age ([link]). In fact, it appears that this is occurring even before we are born. Newborns show preference for their mother’s voice and appear to be able to discriminate between the language spoken by their mother and other

languages. Babies are also attuned to the languages being used around them and show preferences for videos of faces that are moving in synchrony with the audio of spoken language versus videos that do not synchronize with the audio (Blossom & Morgan, 2006; Pickens, 1994; Spelke & Cortelyou, 1981).

Stage	Age	Developmental Language and Communication
1	0–3 months	Reflexive communication
2	3–8 months	Reflexive communication; interest in others
3	8–13 months	Intentional communication; sociability
4	12–18 months	First words
5	18–24 months	Simple sentences of two words
6	2–3 years	Sentences of three or more words
7	3–5 years	Complex sentences; has conversations

Stages of Language and Communication Development

You may recall that each language has its own set of phonemes that are used to generate morphemes, words, and so on. Babies can discriminate

among the sounds that make up a language (for example, they can tell the difference between the “s” in vision and the “ss” in fission); early on, they can differentiate between the sounds of all human languages, even those that do not occur in the languages that are used in their environments. However, by the time that they are about 1 year old, they can only discriminate among those phonemes that are used in the language or languages in their environments (Jensen, 2011; Werker & Lalonde, 1988; Werker & Tees, 1984).

After the first few months of life, babies enter what is known as the babbling stage, during which time they tend to produce single syllables that are repeated over and over. As time passes, more variations appear in the syllables that they produce. During this time, it is unlikely that the babies are trying to communicate; they are just as likely to babble when they are alone as when they are with their caregivers (Fernández & Cairns, 2011). Interestingly, babies who are raised in environments in which sign language is used will also begin to show babbling in the gestures of their hands during this stage (Petitto, Holowka, Sergio, Levy, & Ostry, 2004).

Generally, a child’s first word is uttered sometime between the ages of 1 year to 18 months, and for the next few months, the child will remain in the “one word” stage of language development. During this time, children know a number of words, but they only produce one-word utterances. The child’s early vocabulary is limited to familiar objects or events, often nouns. Although children in this stage only make one-word utterances, these words often carry larger meaning (Fernández & Cairns, 2011). So, for example, a child saying “cookie” could be identifying a cookie or asking for a cookie.

As a child’s lexicon grows, she begins to utter simple sentences and to acquire new vocabulary at a very rapid pace. In addition, children begin to demonstrate a clear understanding of the specific rules that apply to their language(s). Even the mistakes that children sometimes make provide evidence of just how much they understand about those rules. This is sometimes seen in the form of **overgeneralization**. In this context, overgeneralization refers to an extension of a language rule to an exception to the rule. For example, in English, it is usually the case that an “s” is added to the end of a word to indicate plurality. For example, we speak of

one dog versus two dogs. Young children will overgeneralize this rule to cases that are exceptions to the “add an s to the end of the word” rule and say things like “those two gooses” or “three mouses.” Clearly, the rules of the language are understood, even if the exceptions to the rules are still being learned (Moskowitz, 1978).

LANGUAGE AND THOUGHT

When we speak one language, we agree that words are representations of ideas, people, places, and events. The given language that children learn is connected to their culture and surroundings. But can words themselves shape the way we think about things? Psychologists have long investigated the question of whether language shapes thoughts and actions, or whether our thoughts and beliefs shape our language. Two researchers, Edward Sapir and Benjamin Lee Whorf, began this investigation in the 1940s. They wanted to understand how the language habits of a community encourage members of that community to interpret language in a particular manner (Sapir, 1941/1964). Sapir and Whorf proposed that language determines thought, suggesting, for example, that a person whose community language did not have past-tense verbs would be challenged to think about the past (Whorf, 1956). Researchers have since identified this view as too absolute, pointing out a lack of empiricism behind what Sapir and Whorf proposed (Abler, 2013; Boroditsky, 2011; van Troyer, 1994). Today, psychologists continue to study and debate the relationship between language and thought.

Language may indeed influence the way that we think, an idea known as linguistic determinism. One recent demonstration of this phenomenon involved differences in the way that English and Mandarin Chinese speakers talk and think about time. English speakers tend to talk about time using terms that describe changes along a horizontal dimension, for example, saying something like “I’m running behind schedule” or “Don’t get ahead of yourself.” While Mandarin Chinese speakers also describe time in horizontal terms, it is not uncommon to also use terms associated with a vertical arrangement. For example, the past might be described as being “up” and the future as being “down.” It turns out that these differences in language translate into differences in performance on

cognitive tests designed to measure how quickly an individual can recognize temporal relationships. Specifically, when given a series of tasks with vertical priming, Mandarin Chinese speakers were faster at recognizing temporal relationships between months. Indeed, Boroditsky (2001) sees these results as suggesting that “habits in language encourage habits in thought” (p. 12).

One group of researchers who wanted to investigate how language influences thought compared how English speakers and the Dani people of Papua New Guinea think and speak about color. The Dani have two words for color: one word for *light* and one word for *dark*. In contrast, the English language has 11 color words. Researchers hypothesized that the number of color terms could limit the ways that the Dani people conceptualized color. However, the Dani were able to distinguish colors with the same ability as English speakers, despite having fewer words at their disposal (Berlin & Kay, 1969). A recent review of research aimed at determining how language might affect something like color perception suggests that language can influence perceptual phenomena, especially in the left hemisphere of the brain. You may recall from earlier chapters that the left hemisphere is associated with language for most people. However, the right (less linguistic hemisphere) of the brain is less affected by linguistic influences on perception (Regier & Kay, 2009)

Summary

Language is a communication system that has both a lexicon and a system of grammar. Language acquisition occurs naturally and effortlessly during the early stages of life, and this acquisition occurs in a predictable sequence for individuals around the world. Language has a strong influence on thought, and the concept of how language may influence cognition remains an area of study and debate in psychology.

Review Questions

Exercise:

Problem:

_____ provides general principles for organizing words into meaningful sentences.

A. Linguistic determinism
B. Lexicon
C. Semantics
D. Syntax

Solution:

D

Exercise:

Problem:

_____ are the smallest unit of language that carry meaning.

A. Lexicon
B. Phonemes
C. Morphemes
D. Syntax

Solution:

C

Exercise:

Problem:

The meaning of words and phrases is determined by applying the rules of _____.

A. lexicon
B. phonemes

C. overgeneralization
D. semantics

Solution:

D

Exercise:

Problem:

_____ is (are) the basic sound units of a spoken language.

A. Syntax
B. Phonemes
C. Morphemes
D. Grammar

Solution:

B

Critical Thinking Questions

Exercise:

Problem:

How do words not only represent our thoughts but also represent our values?

Solution:

People tend to talk about the things that are important to them or the things they think about the most. What we talk about, therefore, is a reflection of our values.

Exercise:

Problem:

How could grammatical errors actually be indicative of language acquisition in children?

Solution:

People tend to talk about the things that are important to them or the things they think about the most. What we talk about, therefore, is a reflection of our values.

Exercise:

Problem:

How do words not only represent our thoughts but also represent our values?

Solution:

Grammatical errors that involve overgeneralization of specific rules of a given language indicate that the child recognizes the rule, even if he or she doesn't recognize all of the subtleties or exceptions involved in the rule's application.

Glossary

grammar
: set of rules that are used to convey meaning through the use of a lexicon

language
: communication system that involves using words to transmit information from one individual to another

lexicon
: the words of a given language

morpheme
: smallest unit of language that conveys some type of meaning

overgeneralization
: extension of a rule that exists in a given language to an exception to the rule

phoneme
: basic sound unit of a given language

semantics
: process by which we derive meaning from morphemes and words

syntax
: manner by which words are organized into sentences

9.3 Problem Solving

By the end of this section, you will be able to:

- Describe problem solving strategies
- Define algorithm and heuristic
- Explain some common roadblocks to effective problem solving

People face problems every day—usually, multiple problems throughout the day. Sometimes these problems are straightforward: To double a recipe for pizza dough, for example, all that is required is that each ingredient in the recipe be doubled. Sometimes, however, the problems we encounter are more complex. For example, say you have a work deadline, and you must mail a printed copy of a report to your supervisor by the end of the business day. The report is time-sensitive and must be sent overnight. You finished the report last night, but your printer will not work today. What should you do? First, you need to identify the problem and then apply a strategy for solving the problem.

PROBLEM-SOLVING STRATEGIES

When you are presented with a problem—whether it is a complex mathematical problem or a broken printer, how do you solve it? Before finding a solution to the problem, the problem must first be clearly identified. After that, one of many problem solving strategies can be applied, hopefully resulting in a solution.

A **problem-solving strategy** is a plan of action used to find a solution. Different strategies have different action plans associated with them ([link]). For example, a well-known strategy is **trial and error**. The old adage, “If at first you don’t succeed, try, try again” describes trial and error. In terms of your broken printer, you could try checking the ink levels, and if that doesn’t work, you could check to make sure the paper tray isn’t jammed. Or maybe the printer isn’t actually connected to your laptop. When using trial and error, you would continue to try different solutions until you solved your problem. Although trial and error is not typically one of the most time-efficient strategies, it is a commonly used one.

Method	Description	Example
Trial and error	Continue trying different solutions until problem is solved	Restarting phone, turning off WiFi, turning off bluetooth in order to determine why your phone is malfunctioning
Algorithm	Step-by-step problem-solving formula	Instruction manual for installing new software on your computer
Heuristic	General problem-solving framework	Working backwards; breaking a task into steps

Problem-Solving Strategies

Another type of strategy is an algorithm. An **algorithm** is a problem-solving formula that provides you with step-by-step instructions used to achieve a desired outcome (Kahneman, 2011). You can think of an algorithm as a recipe with highly detailed instructions that produce the same result every time they are performed. Algorithms are used frequently in our everyday lives, especially in computer science. When you run a search on the Internet, search engines like Google use algorithms to decide which entries will appear first in your list of results. Facebook also uses algorithms to decide which posts to display on your newsfeed. Can you identify other situations in which algorithms are used?

A heuristic is another type of problem solving strategy. While an algorithm must be followed exactly to produce a correct result, a **heuristic** is a general problem-solving framework (Tversky & Kahneman, 1974). You can think of these as mental shortcuts that are used to solve problems. A “rule of thumb” is an example of a heuristic. Such a rule saves the person time and energy when making a decision, but despite its time-saving characteristics,

it is not always the best method for making a rational decision. Different types of heuristics are used in different types of situations, but the impulse to use a heuristic occurs when one of five conditions is met (Pratkanis, 1989):

- When one is faced with too much information
- When the time to make a decision is limited
- When the decision to be made is unimportant
- When there is access to very little information to use in making the decision
- When an appropriate heuristic happens to come to mind in the same moment

Working backwards is a useful heuristic in which you begin solving the problem by focusing on the end result. Consider this example: You live in Washington, D.C. and have been invited to a wedding at 4 PM on Saturday in Philadelphia. Knowing that Interstate 95 tends to back up any day of the week, you need to plan your route and time your departure accordingly. If you want to be at the wedding service by 3:30 PM, and it takes 2.5 hours to get to Philadelphia without traffic, what time should you leave your house? You use the working backwards heuristic to plan the events of your day on a regular basis, probably without even thinking about it.

Another useful heuristic is the practice of accomplishing a large goal or task by breaking it into a series of smaller steps. Students often use this common method to complete a large research project or long essay for school. For example, students typically brainstorm, develop a thesis or main topic, research the chosen topic, organize their information into an outline, write a rough draft, revise and edit the rough draft, develop a final draft, organize the references list, and proofread their work before turning in the project. The large task becomes less overwhelming when it is broken down into a series of small steps.

PITFALLS TO PROBLEM SOLVING

Not all problems are successfully solved, however. What challenges stop us from successfully solving a problem? Albert Einstein once said, “Insanity is

doing the same thing over and over again and expecting a different result." Imagine a person in a room that has four doorways. One doorway that has always been open in the past is now locked. The person, accustomed to exiting the room by that particular doorway, keeps trying to get out through the same doorway even though the other three doorways are open. The person is stuck—but she just needs to go to another doorway, instead of trying to get out through the locked doorway. A **mental set** is where you persist in approaching a problem in a way that has worked in the past but is clearly not working now.

Functional fixedness is a type of mental set where you cannot perceive an object being used for something other than what it was designed for. During the *Apollo 13* mission to the moon, NASA engineers at Mission Control had to overcome functional fixedness to save the lives of the astronauts aboard the spacecraft. An explosion in a module of the spacecraft damaged multiple systems. The astronauts were in danger of being poisoned by rising levels of carbon dioxide because of problems with the carbon dioxide filters. The engineers found a way for the astronauts to use spare plastic bags, tape, and air hoses to create a makeshift air filter, which saved the lives of the astronauts.

Researchers have investigated whether functional fixedness is affected by culture. In one experiment, individuals from the Shuar group in Ecuador were asked to use an object for a purpose other than that for which the object was originally intended. For example, the participants were told a story about a bear and a rabbit that were separated by a river and asked to select among various objects, including a spoon, a cup, erasers, and so on, to help the animals. The spoon was the only object long enough to span the imaginary river, but if the spoon was presented in a way that reflected its normal usage, it took participants longer to choose the spoon to solve the problem. (German & Barrett, 2005). The researchers wanted to know if exposure to highly specialized tools, as occurs with individuals in industrialized nations, affects their ability to transcend functional fixedness. It was determined that functional fixedness is experienced in both industrialized and nonindustrialized cultures (German & Barrett, 2005).

In order to make good decisions, we use our knowledge and our reasoning. Often, this knowledge and reasoning is sound and solid. Sometimes, however, we are swayed by biases or by others manipulating a situation. For example, let's say you and three friends wanted to rent a house and had a combined target budget of $1,600. The realtor shows you only very run-down houses for $1,600 and then shows you a very nice house for $2,000. Might you ask each person to pay more in rent to get the $2,000 home? Why would the realtor show you the run-down houses and the nice house? The realtor may be challenging your anchoring bias. An **anchoring bias** occurs when you focus on one piece of information when making a decision or solving a problem. In this case, you're so focused on the amount of money you are willing to spend that you may not recognize what kinds of houses are available at that price point.

The **confirmation bias** is the tendency to focus on information that confirms your existing beliefs. For example, if you think that your professor is not very nice, you notice all of the instances of rude behavior exhibited by the professor while ignoring the countless pleasant interactions he is involved in on a daily basis. **Hindsight bias** leads you to believe that the event you just experienced was predictable, even though it really wasn't. In other words, you knew all along that things would turn out the way they did. **Representative bias** describes a faulty way of thinking, in which you unintentionally stereotype someone or something; for example, you may assume that your professors spend their free time reading books and engaging in intellectual conversation, because the idea of them spending their time playing volleyball or visiting an amusement park does not fit in with your stereotypes of professors.

Finally, the **availability heuristic** is a heuristic in which you make a decision based on an example, information, or recent experience that is that readily available to you, even though it may not be the best example to inform your decision**.** Biases tend to "preserve that which is already established—to maintain our preexisting knowledge, beliefs, attitudes, and hypotheses" (Aronson, 1995; Kahneman, 2011). These biases are summarized in [link].

Bias	Description
Anchoring	Tendency to focus on one particular piece of information when making decisions or problem-solving
Confirmation	Focuses on information that confirms existing beliefs
Hindsight	Belief that the event just experienced was predictable
Representative	Unintentional stereotyping of someone or something
Availability	Decision is based upon either an available precedent or an example that may be faulty

Summary of Decision Biases

Summary

Many different strategies exist for solving problems. Typical strategies include trial and error, applying algorithms, and using heuristics. To solve a large, complicated problem, it often helps to break the problem into smaller steps that can be accomplished individually, leading to an overall solution. Roadblocks to problem solving include a mental set, functional fixedness, and various biases that can cloud decision making skills.

Review Questions

Exercise:

Problem:

A specific formula for solving a problem is called _____.

A. an algorithm
B. a heuristic
C. a mental set
D. trial and error

Solution:

A

Exercise:

Problem:

A mental shortcut in the form of a general problem-solving framework is called _____.

A. an algorithm
B. a heuristic
C. a mental set
D. trial and error

Solution:

B

Exercise:

Problem:

Which type of bias involves becoming fixated on a single trait of a problem?

A. anchoring bias
B. confirmation bias
C. representative bias
D. availability bias

Solution:

A

Exercise:

Problem:

Which type of bias involves relying on a false stereotype to make a decision?

A. anchoring bias
B. confirmation bias
C. representative bias
D. availability bias

Solution:

C

Critical Thinking Questions

Exercise:

Problem:

What is functional fixedness and how can overcoming it help you solve problems?

Solution:

Functional fixedness occurs when you cannot see a use for an object other than the use for which it was intended. For example, if you need something to hold up a tarp in the rain, but only have a pitchfork, you must overcome your expectation that a pitchfork can only be used for garden chores before you realize that you could stick it in the ground and drape the tarp on top of it to hold it up.

Exercise:

Problem:

How does an algorithm save you time and energy when solving a problem?

Solution:

An algorithm is a proven formula for achieving a desired outcome. It saves time because if you follow it exactly, you will solve the problem without having to figure out how to solve the problem. It is a bit like not reinventing the wheel.

Glossary

algorithm
: problem-solving strategy characterized by a specific set of instructions

anchoring bias
: faulty heuristic in which you fixate on a single aspect of a problem to find a solution

availability heuristic
: faulty heuristic in which you make a decision based on information readily available to you

confirmation bias
: faulty heuristic in which you focus on information that confirms your beliefs

functional fixedness
: inability to see an object as useful for any other use other than the one for which it was intended

heuristic
: mental shortcut that saves time when solving a problem

hindsight bias

belief that the event just experienced was predictable, even though it really wasn’t

mental set
: continually using an old solution to a problem without results

problem-solving strategy
: method for solving problems

representative bias
: faulty heuristic in which you stereotype someone or something without a valid basis for your judgment

trial and error
: problem-solving strategy in which multiple solutions are attempted until the correct one is found

working backwards
: heuristic in which you begin to solve a problem by focusing on the end result

9.4 What Are Intelligence and Creativity?
By the end of this section, you will be able to:

- Define intelligence
- Explain the triarchic theory of intelligence
- Identify the difference between intelligence theories
- Explain emotional intelligence

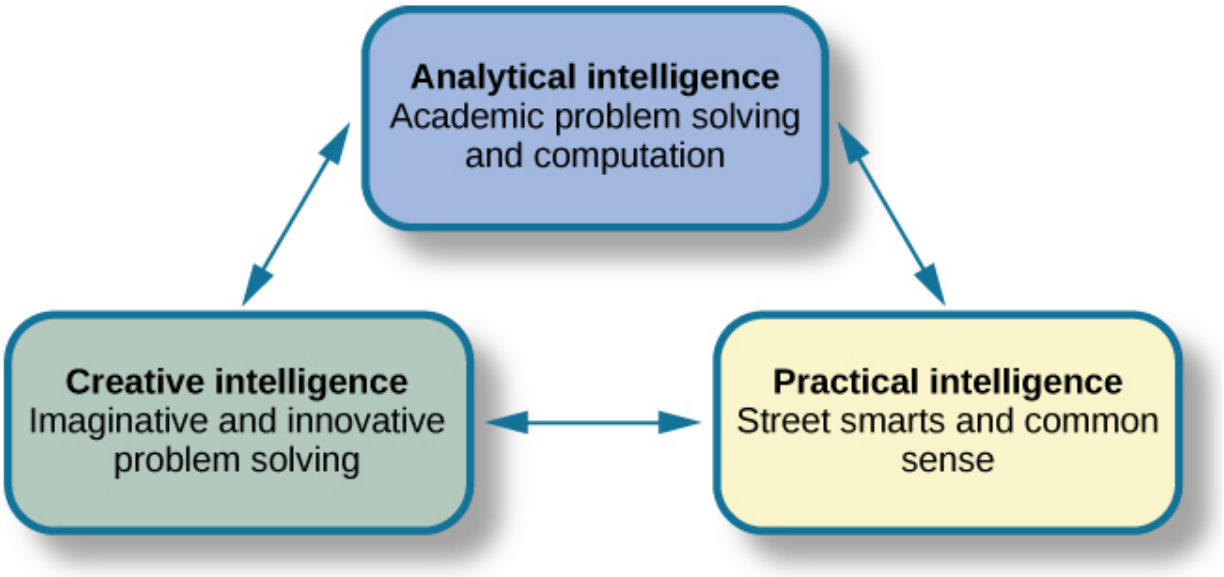
CLASSIFYING INTELLIGENCE

What exactly is intelligence? The way that researchers have defined the concept of intelligence has been modified many times since the birth of psychology. British psychologist Charles Spearman believed intelligence consisted of one general factor, called *g*, which could be measured and compared among individuals. Spearman focused on the commonalities among various intellectual abilities and demphasized what made each unique. Long before modern psychology developed, however, ancient philosophers, such as Aristotle, held a similar view (Cianciolo & Sternberg, 2004).

Others psychologists believe that instead of a single factor, intelligence is a collection of distinct abilities. In the 1940s, Raymond Cattell proposed a theory of intelligence that divided general intelligence into two components: crystallized intelligence and fluid intelligence (Cattell, 1963). **Crystallized intelligence** is characterized as acquired knowledge and the ability to retrieve it. When you learn, remember, and recall information, you are using crystallized intelligence. You use crystallized intelligence all the time in your coursework by demonstrating that you have mastered the information covered in the course. **Fluid intelligence** encompasses the ability to see complex relationships and solve problems. Navigating your way home after being detoured onto an unfamiliar route because of road construction would draw upon your fluid intelligence. Fluid intelligence helps you tackle complex, abstract challenges in your daily life, whereas crystallized intelligence helps you overcome concrete, straightforward problems (Cattell, 1963).

Other theorists and psychologists believe that intelligence should be defined in more practical terms. For example, what types of behaviors help you get ahead in life? Which skills promote success? Think about this for a moment. Being able to recite all 44 presidents of the United States in order is an excellent party trick, but will knowing this make you a better person?

Robert Sternberg developed another theory of intelligence, which he titled the **triarchic theory of intelligence** because it sees intelligence as comprised of three parts (Sternberg, 1988): practical, creative, and analytical intelligence ([link]).



Sternberg's theory identifies three types of intelligence: practical, creative, and analytical.

Practical intelligence, as proposed by Sternberg, is sometimes compared to "street smarts." Being practical means you find solutions that work in your everyday life by applying knowledge based on your experiences. This type of intelligence appears to be separate from traditional understanding of IQ; individuals who score high in practical intelligence may or may not have comparable scores in creative and analytical intelligence (Sternberg, 1988).

This story about the 2007 Virginia Tech shootings illustrates both high and low practical intelligences. During the incident, one student left her class to go get a soda in an adjacent building. She planned to return to class, but when she returned to her building after getting her soda, she saw that the door she used to leave was now chained shut from the inside. Instead of thinking about why there was a chain around the door handles, she went to her class's window and crawled back into the room. She thus potentially exposed herself to the gunman. Thankfully, she was not shot. On the other hand, a pair of students was walking on campus when they heard gunshots nearby. One friend said, "Let's go check it out and see what is going on." The other student said, "No way, we need to run away from the gunshots." They did just that. As a result, both avoided harm. The student who crawled through the window demonstrated some creative intelligence but did not use common sense. She would have low practical intelligence. The student who encouraged his friend to run away from the sound of gunshots would have much higher practical intelligence.

Analytical intelligence is closely aligned with academic problem solving and computations. Sternberg says that analytical intelligence is demonstrated by an ability to analyze, evaluate, judge, compare, and contrast. When reading a classic novel for literature class, for example, it is usually necessary to compare the motives of the main characters of the book or analyze the historical context of the story. In a science course such as anatomy, you must study the processes by which the body uses various minerals in different human systems. In developing an understanding of this topic, you are using analytical intelligence. When solving a challenging math problem, you would apply analytical intelligence to analyze different aspects of the problem and then solve it section by section.

Creative intelligence is marked by inventing or imagining a solution to a problem or situation. Creativity in this realm can include finding a novel solution to an unexpected problem or producing a beautiful work of art or a well-developed short story. Imagine for a moment that you are camping in the woods with some friends and realize that you've forgotten your camp coffee pot. The person in your group who figures out a way to successfully brew coffee for everyone would be credited as having higher creative intelligence.

Multiple Intelligences Theory was developed by Howard Gardner, a Harvard psychologist and former student of Erik Erikson. Gardner's theory, which has been refined for more than 30 years, is a more recent development among theories of intelligence. In Gardner's theory, each person possesses at least eight intelligences. Among these eight intelligences, a person typically excels in some and falters in others (Gardner, 1983). [link] describes each type of intelligence.

Intelligence Type	**Characteristics**	**Representative Career**
Linguistic intelligence	Perceives different functions of language, different sounds and meanings of words, may easily learn multiple languages	Journalist, novelist, poet, teacher
Logical-mathematical intelligence	Capable of seeing numerical patterns, strong ability to use reason and logic	Scientist, mathematician
Musical intelligence	Understands and appreciates rhythm, pitch, and tone; may play multiple instruments or perform as a vocalist	Composer, performer
Bodily kinesthetic intelligence	High ability to control the movements of the body and use the body to perform various physical tasks	Dancer, athlete, athletic coach, yoga instructor

Intelligence Type	Characteristics	Representative Career
Spatial intelligence	Ability to perceive the relationship between objects and how they move in space	Choreographer, sculptor, architect, aviator, sailor
Interpersonal intelligence	Ability to understand and be sensitive to the various emotional states of others	Counselor, social worker, salesperson
Intrapersonal intelligence	Ability to access personal feelings and motivations, and use them to direct behavior and reach personal goals	Key component of personal success over time
Naturalist intelligence	High capacity to appreciate the natural world and interact with the species within it	Biologist, ecologist, environmentalist

Multiple Intelligences

CREATIVITY

Creativity is the ability to generate, create, or discover new ideas, solutions, and possibilities. Very creative people often have intense knowledge about something, work on it for years, look at novel solutions, seek out the advice and help of other experts, and take risks. Although creativity is often associated with the arts, it is actually a vital form of intelligence that drives people in many disciplines to discover something new. Creativity can be found in every area of life, from the way you decorate your residence to a new way of understanding how a cell works.

Creativity is often assessed as a function of one's ability to engage in **divergent thinking**. Divergent thinking can be described as thinking "outside the box;" it allows an individual to arrive at unique, multiple solutions to a given problem. In contrast, **convergent thinking** describes the ability to provide a correct or well-established answer or solution to a problem (Cropley, 2006; Gilford, 1967)

Note:
Creativity

Summary

Intelligence is a complex characteristic of cognition. Many theories have been developed to explain what intelligence is and how it works. Sternberg generated his triarchic theory of intelligence, whereas Gardner posits that intelligence is comprised of many factors. Still others focus on the importance of emotional intelligence. Finally, creativity seems to be a facet of intelligence, but it is extremely difficult to measure objectively.

Review Questions

Exercise:

Problem: Fluid intelligence is characterized by _____.

A. being able to recall information
B. being able to create new products
C. being able to understand and communicate with different cultures
D. being able to see complex relationships and solve problems

---

Solution:

D

Exercise:

Problem:

Which of the following is not one of Gardner’s Multiple Intelligences?

A. creative
B. spatial
C. linguistic
D. musical

Solution:

A

Exercise:

Problem: Which theorist put forth the triarchic theory of intelligence?

A. Goleman
B. Gardner
C. Sternberg
D. Steitz

Solution:

C

Exercise:

Problem:

When you are examining data to look for trends, which type of intelligence are you using most?

A. practical
B. analytical

C. emotional
D. creative

Solution:

B

Critical Thinking Questions

Exercise:

Problem:

Describe a situation in which you would need to use practical intelligence.

Solution:

You are out with friends and it is getting late. You need to make it home before your curfew, but you don’t have a ride home. You need to get in touch with your parents, but your cell phone is dead. So, you enter a nearby convenience store and explain your situation to the clerk. He allows you to use the store’s phone to call your parents, and they come and pick you and your friends up, and take all of you home.

Exercise:

Problem:

Describe a situation in which cultural intelligence would help you communicate better.

Solution:

You are visiting Madrid, Spain, on a language immersion trip. Your Spanish is okay, but you still not sure about some of the facial expressions and body language of the native speakers. When faced with a sticky social situation, you do not engage immediately as you

might back home. Instead, you hold back and observe what others are doing before reacting.

Glossary

analytical intelligence
: aligned with academic problem solving and computations

convergent thinking
: providing correct or established answers to problems

creative intelligence
: ability to produce new products, ideas, or inventing a new, novel solution to a problem

creativity
: ability to generate, create, or discover new ideas, solutions, and possibilities

crystallized intelligence
: characterized by acquired knowledge and the ability to retrieve it

cultural intelligence
: ability with which people can understand and relate to those in another culture

divergent thinking
: ability to think “outside the box” to arrive at novel solutions to a problem

emotional intelligence
: ability to understand emotions and motivations in yourself and others

fluid intelligence
: ability to see complex relationships and solve problems

Multiple Intelligences Theory

Gardner’s theory that each person possesses at least eight types of intelligence

practical intelligence
: aka “street smarts”

triarchic theory of intelligence
: Sternberg’s theory of intelligence; three facets of intelligence: practical, creative, and analytical

9.5 Measures of Intelligence
By the end of this section, you will be able to:

- Explain how intelligence tests are developed
- Describe the history of the use of IQ tests
- Describe the purposes and benefits of intelligence testing

While you're likely familiar with the term "IQ" and associate it with the idea of intelligence, what does IQ really mean? IQ stands for **intelligence quotient** and describes a score earned on a test designed to measure intelligence. You've already learned that there are many ways psychologists describe intelligence (or more aptly, intelligences). Similarly, IQ tests—the tools designed to measure intelligence—have been the subject of debate throughout their development and use.

When might an IQ test be used? What do we learn from the results, and how might people use this information? IQ tests are expensive to administer and must be given by a licensed psychologist. Intelligence testing has been considered both a bane and a boon for education and social policy. In this section, we will explore what intelligence tests measure, how they are scored, and how they were developed.

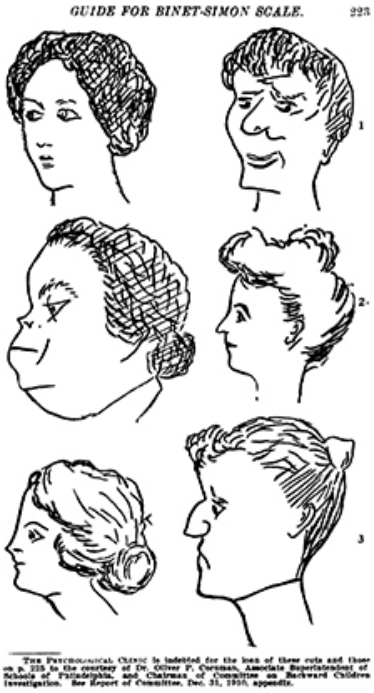
MEASURING INTELLIGENCE

It seems that the human understanding of intelligence is somewhat limited when we focus on traditional or academic-type intelligence. How then, can intelligence be measured? And when we measure intelligence, how do we ensure that we capture what we're really trying to measure (in other words, that IQ tests function as valid measures of intelligence)? In the following paragraphs, we will explore the how intelligence tests were developed and the history of their use.

The IQ test has been synonymous with intelligence for over a century. In the late 1800s, Sir Francis Galton developed the first broad test of intelligence (Flanagan & Kaufman, 2004). Although he was not a psychologist, his contributions to the concepts of intelligence testing are still felt today (Gordon, 1995). Reliable intelligence testing (you may recall

from earlier chapters that reliability refers to a test's ability to produce consistent results) began in earnest during the early 1900s with a researcher named Alfred Binet ([link]). Binet was asked by the French government to develop an intelligence test to use on children to determine which ones might have difficulty in school; it included many verbally based tasks. American researchers soon realized the value of such testing. Louis Terman, a Stanford professor, modified Binet's work by standardizing the administration of the test and tested thousands of different-aged children to establish an average score for each age. As a result, the test was normed and standardized, which means that the test was administered consistently to a large enough representative sample of the population that the range of scores resulted in a bell curve (bell curves will be discussed later). **Standardization** means that the manner of administration, scoring, and interpretation of results is consistent. **Norming** involves giving a test to a large population so data can be collected comparing groups, such as age groups. The resulting data provide norms, or referential scores, by which to interpret future scores. Norms are not expectations of what a given group *should* know but a demonstration of what that group *does* know. Norming and standardizing the test ensures that new scores are reliable. This new version of the test was called the Stanford-Binet Intelligence Scale (Terman, 1916). Remarkably, an updated version of this test is still widely used today.

(a)



(b)

French psychologist Alfred Binet helped to develop intelligence testing. (b) This page is from a 1908 version of the Binet-Simon Intelligence Scale. Children being tested were asked which face, of each pair, was prettier.

In 1939, David Wechsler, a psychologist who spent part of his career working with World War I veterans, developed a new IQ test in the United States. Wechsler combined several subtests from other intelligence tests used between 1880 and World War I. These subtests tapped into a variety of verbal and nonverbal skills, because Wechsler believed that intelligence encompassed “the global capacity of a person to act purposefully, to think rationally, and to deal effectively with his environment” (Wechsler, 1958, p. 7). He named the test the Wechsler-Bellevue Intelligence Scale (Wechsler, 1981). This combination of subtests became one of the most extensively used intelligence tests in the history of psychology. Although its name was

later changed to the Wechsler Adult Intelligence Scale (WAIS) and has been revised several times, the aims of the test remain virtually unchanged since its inception (Boake, 2002). Today, there are three intelligence tests credited to Wechsler, the Wechsler Adult Intelligence Scale-fourth edition (WAIS-IV), the Wechsler Intelligence Scale for Children (WISC-V), and the Wechsler Preschool and Primary Scale of Intelligence—Revised (WPPSI-III) (Wechsler, 2002). These tests are used widely in schools and communities throughout the United States, and they are periodically normed and standardized as a means of recalibration. Interestingly, the periodic recalibrations have led to an interesting observation known as the Flynn effect. Named after James Flynn, who was among the first to describe this trend, the **Flynn effect** refers to the observation that each generation has a significantly higher IQ than the last. Flynn himself argues, however, that increased IQ scores do not necessarily mean that younger generations are more intelligent per se (Flynn, Shaughnessy, & Fulgham, 2012). As a part of the recalibration process, the WISC-V (which is scheduled to be released in 2014) was given to thousands of children across the country, and children taking the test today are compared with their same-age peers ([link]).

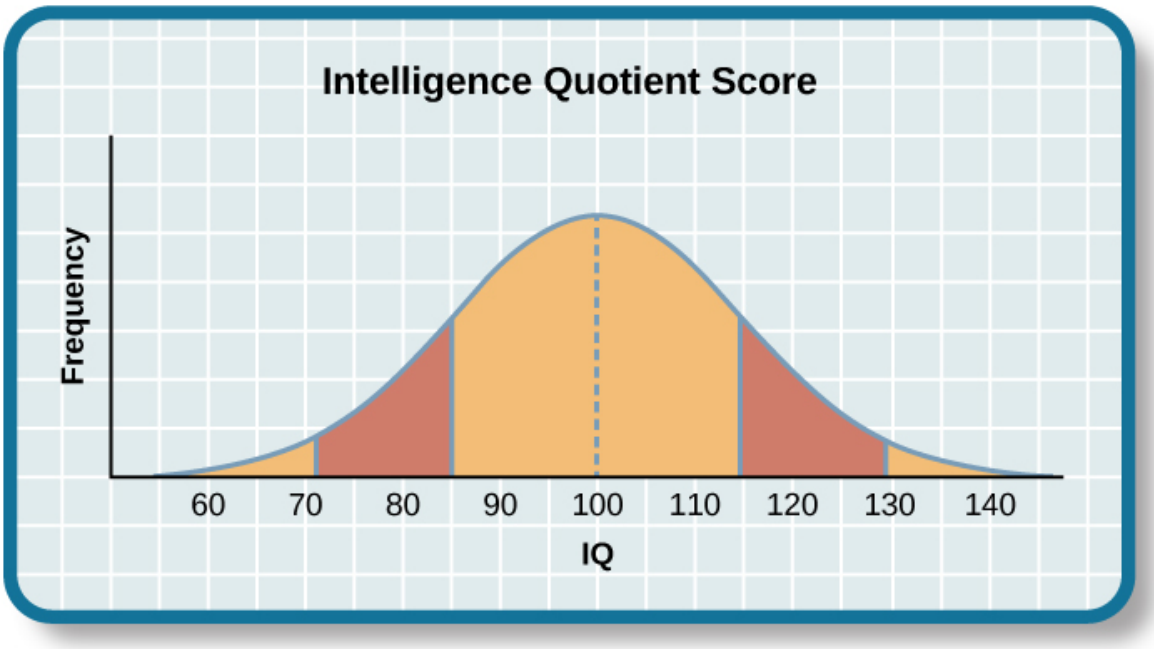
The WISC-V is composed of 10 subtests, which comprise four indices, which then render an IQ score. The four indices are Verbal Comprehension, Perceptual Reasoning, Working Memory, and Processing Speed. When the test is complete, individuals receive a score for each of the four indices and a Full Scale IQ score (Heaton, 2004). The method of scoring reflects the understanding that intelligence is comprised of multiple abilities in several cognitive realms and focuses on the mental processes that the child used to arrive at his or her answers to each test item (Heaton, 2004).

Ultimately, we are still left with the question of how valid intelligence tests are. Certainly, the most modern versions of these tests tap into more than verbal competencies, yet the specific skills that should be assessed in IQ testing, the degree to which any test can truly measure an individual’s intelligence, and the use of the results of IQ tests are still issues of debate (Gresham & Witt, 1997; Flynn, Shaughnessy, & Fulgham, 2012; Richardson, 2002; Schlinger, 2003).

THE BELL CURVE

The results of intelligence tests follow the bell curve, a graph in the general shape of a bell. When the bell curve is used in psychological testing, the graph demonstrates a normal distribution of a trait, in this case, intelligence, in the human population. Many human traits naturally follow the bell curve. For example, if you lined up all your female schoolmates according to height, it is likely that a large cluster of them would be the average height for an American woman: 5’4”–5’6”. This cluster would fall in the center of the bell curve, representing the average height for American women. There would be fewer women who stand closer to 4’11”. The same would be true for women of above-average height: those who stand closer to 5’11”. The trick to finding a bell curve in nature is to use a large sample size. Without a large sample size, it is less likely that the bell curve will represent the wider population. A **representative sample** is a subset of the population that accurately represents the general population. If, for example, you measured the height of the women in your classroom only, you might not actually have a representative sample. Perhaps the women’s basketball team wanted to take this course together, and they are all in your class. Because basketball players tend to be taller than average, the women in your class may not be a good representative sample of the population of American women. But if your sample included all the women at your school, it is likely that their heights would form a natural bell curve.

The same principles apply to intelligence tests scores. Individuals earn a score called an intelligence quotient (IQ). Over the years, different types of IQ tests have evolved, but the way scores are interpreted remains the same. The average IQ score on an IQ test is 100. **Standard deviations** describe how data are dispersed in a population and give context to large data sets. The bell curve uses the standard deviation to show how all scores are dispersed from the average score ([link]). In modern IQ testing, one standard deviation is 15 points. So a score of 85 would be described as “one standard deviation below the mean.” How would you describe a score of 115 and a score of 70? Any IQ score that falls within one standard deviation above and below the mean (between 85 and 115) is considered average, and 82% of the population has IQ scores in this range. An IQ score of 130 or above is considered a superior level.



The majority of people have an IQ score between 85 and 115.

On the other end of the intelligence spectrum are those individuals whose IQs fall into the highest ranges. Consistent with the bell curve, about 2% of the population falls into this category. People are considered gifted if they have an IQ score of 130 or higher, or superior intelligence in a particular area. Long ago, popular belief suggested that people of high intelligence were maladjusted. This idea was disproven through a groundbreaking study of gifted children. In 1921, Lewis Terman began a longitudinal study of over 1500 children with IQs over 135 (Terman, 1925). His findings showed that these children became well-educated, successful adults who were, in fact, well-adjusted (Terman & Oden, 1947). Additionally, Terman's study showed that the subjects were above average in physical build and attractiveness, dispelling an earlier popular notion that highly intelligent people were "weaklings." Some people with very high IQs elect to join Mensa, an organization dedicated to identifying, researching, and fostering intelligence. Members must have an IQ score in the top 2% of the population, and they may be required to pass other exams in their application to join the group.

WHY MEASURE INTELLIGENCE?

The value of IQ testing is most evident in educational or clinical settings. Children who seem to be experiencing learning difficulties or severe behavioral problems can be tested to ascertain whether the child's difficulties can be partly attributed to an IQ score that is significantly different from the mean for her age group. Without IQ testing—or another measure of intelligence—children and adults needing extra support might not be identified effectively. In addition, IQ testing is used in courts to determine whether a defendant has special or extenuating circumstances that preclude him from participating in some way in a trial. People also use IQ testing results to seek disability benefits from the Social Security Administration. While IQ tests have sometimes been used as arguments in support of insidious purposes, such as the eugenics movement (Severson, 2011), the following case study demonstrates the usefulness and benefits of IQ testing.

Candace, a 14-year-old girl experiencing problems at school, was referred for a court-ordered psychological evaluation. She was in regular education classes in ninth grade and was failing every subject. Candace had never been a stellar student but had always been passed to the next grade. Frequently, she would curse at any of her teachers who called on her in class. She also got into fights with other students and occasionally shoplifted. When she arrived for the evaluation, Candace immediately said that she hated everything about school, including the teachers, the rest of the staff, the building, and the homework. Her parents stated that they felt their daughter was picked on, because she was of a different race than the teachers and most of the other students. When asked why she cursed at her teachers, Candace replied, "They only call on me when I don't know the answer. I don't want to say, 'I don't know' all of the time and look like an idiot in front of my friends. The teachers embarrass me." She was given a battery of tests, including an IQ test. Her score on the IQ test was 68. What does Candace's score say about her ability to excel or even succeed in regular education classes without assistance?

Summary

In this section, we learned about the history of intelligence testing and some of the challenges regarding intelligence testing. Intelligence tests began in earnest with Binet; Wechsler later developed intelligence tests that are still in use today: the WAIS-IV and WISC-V. The Bell curve shows the range of scores that encompass average intelligence as well as standard deviations.

Review Questions

Exercise:

Problem:

In order for a test to be normed and standardized it must be tested on _____.

A. a group of same-age peers
B. a representative sample
C. children with mental disabilities
D. children of average intelligence

Solution:

B

Exercise:

Problem:

The mean score for a person with an average IQ is _____.

A. 70
B. 130
C. 85
D. 100

Solution:

D

Exercise:

Problem: Who developed the IQ test most widely used today?

A. Sir Francis Galton
B. Alfred Binet
C. Louis Terman
D. David Wechsler

Solution:

D

Exercise:

Problem:

The DSM-5 now uses _____ as a diagnostic label for what was once referred to as mental retardation.

A. autism and developmental disabilities
B. lowered intelligence
C. intellectual disability
D. cognitive disruption

Solution:

C

Critical Thinking Questions

Exercise:

Problem:

Why do you think different theorists have defined intelligence in different ways?

Solution:

Since cognitive processes are complex, ascertaining them in a measurable way is challenging. Researchers have taken different approaches to define intelligence in an attempt to comprehensively describe and measure it.

Exercise:

Problem:

Compare and contrast the benefits of the Stanford-Binet IQ test and Wechsler's IQ tests.

Solution:

The Wechsler-Bellevue IQ test combined a series of subtests that tested verbal and nonverbal skills into a single IQ test in order to get a reliable, descriptive score of intelligence. While the Stanford-Binet test was normed and standardized, it focused more on verbal skills than variations in other cognitive processes.

Glossary

Flynn effect
: observation that each generation has a significantly higher IQ than the previous generation

intelligence quotient
: (also, IQ) score on a test designed to measure intelligence

norming

administering a test to a large population so data can be collected to reference the normal scores for a population and its groups

representative sample
: subset of the population that accurately represents the general population

standard deviation
: measure of variability that describes the difference between a set of scores and their mean

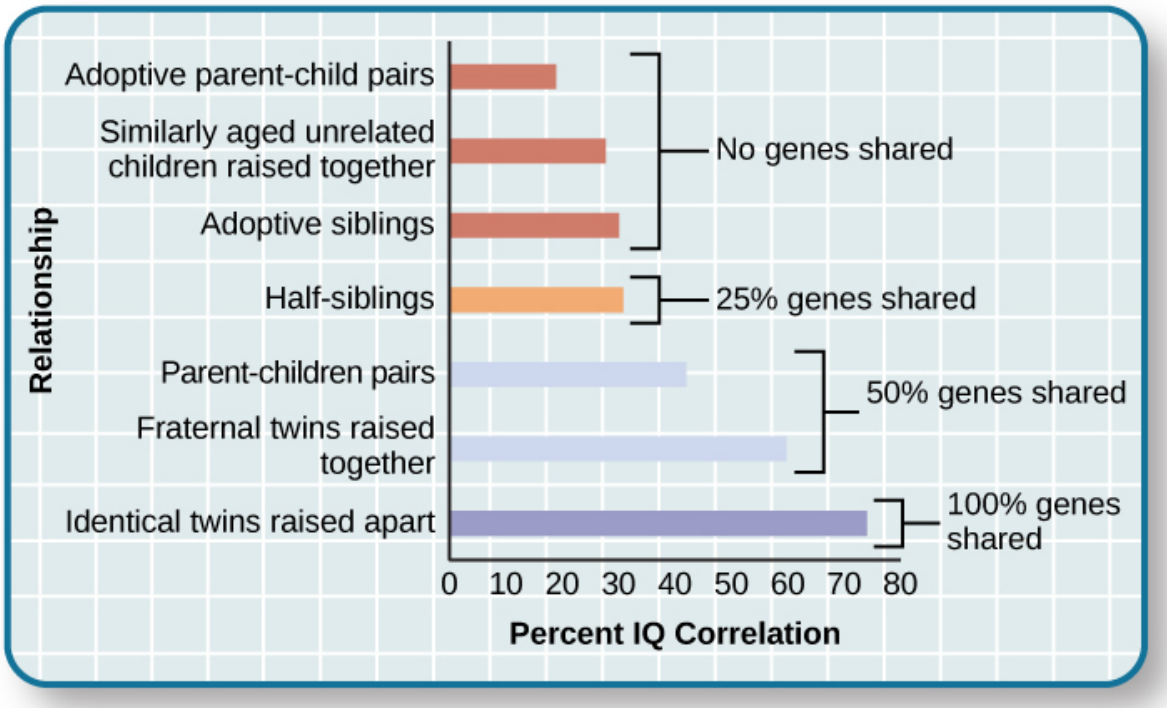
standardization
: method of testing in which administration, scoring, and interpretation of results are consistent

9.6 The Source of Intelligence SW
By the end of this section, you will be able to:

- Describe how genetics and environment affect intelligence
- Explain the relationship between IQ scores and socioeconomic status
- Describe the difference between a learning disability and a developmental disorder

HIGH INTELLIGENCE: NATURE OR NURTURE?

Where does high intelligence come from? Some researchers believe that intelligence is a trait inherited from a person's parents. Scientists who research this topic typically use twin studies to determine the heritability of intelligence. The Minnesota Study of Twins Reared Apart is one of the most well-known twin studies. In this investigation, researchers found that identical twins raised together and identical twins raised apart exhibit a higher correlation between their IQ scores than siblings or fraternal twins raised together (Bouchard, Lykken, McGue, Segal, & Tellegen, 1990). The findings from this study reveal a genetic component to intelligence ([link]). At the same time, other psychologists believe that intelligence is shaped by a child's developmental environment. If parents were to provide their children with intellectual stimuli from before they are born, it is likely that they would absorb the benefits of that stimulation, and it would be reflected in intelligence levels.



The correlations of IQs of unrelated versus related persons reared apart or together suggest a genetic component to intelligence.

The reality is that aspects of each idea are probably correct. In fact, one study suggests that although genetics seem to be in control of the level of intelligence, the environmental influences provide both stability and change to trigger manifestation of cognitive abilities (Bartels, Rietveld, Van Baal, & Boomsma, 2002). Certainly, there are behaviors that support the development of intelligence, but the genetic component of high intelligence should not be ignored. As with all heritable traits, however, it is not always possible to isolate how and when high intelligence is passed on to the next generation.

Another challenge to determining origins of high intelligence is the confounding nature of our human social structures. It is troubling to note that some ethnic groups perform better on IQ tests than others—and it is likely that the results do not have much to do with the quality of each ethnic group's intellect. The same is true for socioeconomic status. Children who

live in poverty experience more pervasive, daily stress than children who do not worry about the basic needs of safety, shelter, and food. These worries can negatively affect how the brain functions and develops, causing a dip in IQ scores. Mark Kishiyama and his colleagues determined that children living in poverty demonstrated reduced prefrontal brain functioning comparable to children with damage to the lateral prefrontal cortex (Kishyama, Boyce, Jimenez, Perry, & Knight, 2009).

The debate around the foundations and influences on intelligence exploded in 1969, when an educational psychologist named Arthur Jensen published the article “How Much Can We Boost I.Q. and Achievement” in the *Harvard Educational Review*. Jensen had administered IQ tests to diverse groups of students, and his results led him to the conclusion that IQ is determined by genetics. He also posited that intelligence was made up of two types of abilities: Level I and Level II. In his theory, Level I is responsible for rote memorization, whereas Level II is responsible for conceptual and analytical abilities. According to his findings, Level I remained consistent among the human race. Level II, however, exhibited differences among ethnic groups (Modgil & Routledge, 1987). Jensen’s most controversial conclusion was that Level II intelligence is prevalent among Asians, then Caucasians, then African Americans. Robert Williams was among those who called out racial bias in Jensen’s results (Williams, 1970).

Obviously, Jensen’s interpretation of his own data caused an intense response in a nation that continued to grapple with the effects of racism (Fox, 2012). However, Jensen’s ideas were not solitary or unique; rather, they represented one of many examples of psychologists asserting racial differences in IQ and cognitive ability. In fact, Rushton and Jensen (2005) reviewed three decades worth of research on the relationship between race and cognitive ability. Jensen’s belief in the inherited nature of intelligence and the validity of the IQ test to be the truest measure of intelligence are at the core of his conclusions. If, however, you believe that intelligence is more than Levels I and II, or that IQ tests do not control for socioeconomic and cultural differences among people, then perhaps you can dismiss Jensen’s conclusions as a single window that looks out on the complicated and varied landscape of human intelligence.

In a related story, parents of African American students filed a case against the State of California in 1979, because they believed that the testing method used to identify students with learning disabilities was culturally unfair as the tests were normed and standardized using white children (*Larry P. v. Riles*). The testing method used by the state disproportionately identified African American children as mentally retarded. This resulted in many students being incorrectly classified as "mentally retarded." According to a summary of the case, *Larry P. v. Riles*:

> In violation of Title VI of the Civil Rights Act of 1964, the Rehabilitation Act of 1973, and the Education for All Handicapped Children Act of 1975, defendants have utilized standardized intelligence tests that are racially and culturally biased, have a discriminatory impact against black children, and have not been validated for the purpose of essentially permanent placements of black children into educationally dead-end, isolated, and stigmatizing classes for the so-called educable mentally retarded. Further, these federal laws have been violated by defendants' general use of placement mechanisms that, taken together, have not been validated and result in a large over-representation of black children in the special E.M.R. classes. (*Larry P. v. Riles*, par. 6)

> Once again, the limitations of intelligence testing were revealed.

WHAT ARE LEARNING DISABILITIES?

Learning disabilities are cognitive disorders that affect different areas of cognition, particularly language or reading. It should be pointed out that learning disabilities are not the same thing as intellectual disabilities. Learning disabilities are considered specific neurological impairments rather than global intellectual or developmental disabilities. A person with a

language disability has difficulty understanding or using spoken language, whereas someone with a reading disability, such as dyslexia, has difficulty processing what he or she is reading.

Often, learning disabilities are not recognized until a child reaches school age. One confounding aspect of learning disabilities is that they often affect children with average to above-average intelligence. At the same time, learning disabilities tend to exhibit comorbidity with other disorders, like attention-deficit hyperactivity disorder (ADHD). Anywhere between 30–70% of individuals with diagnosed cases of ADHD also have some sort of learning disability (Riccio, Gonzales, & Hynd, 1994). Let's take a look at two examples of common learning disabilities: dysgraphia and dyslexia.

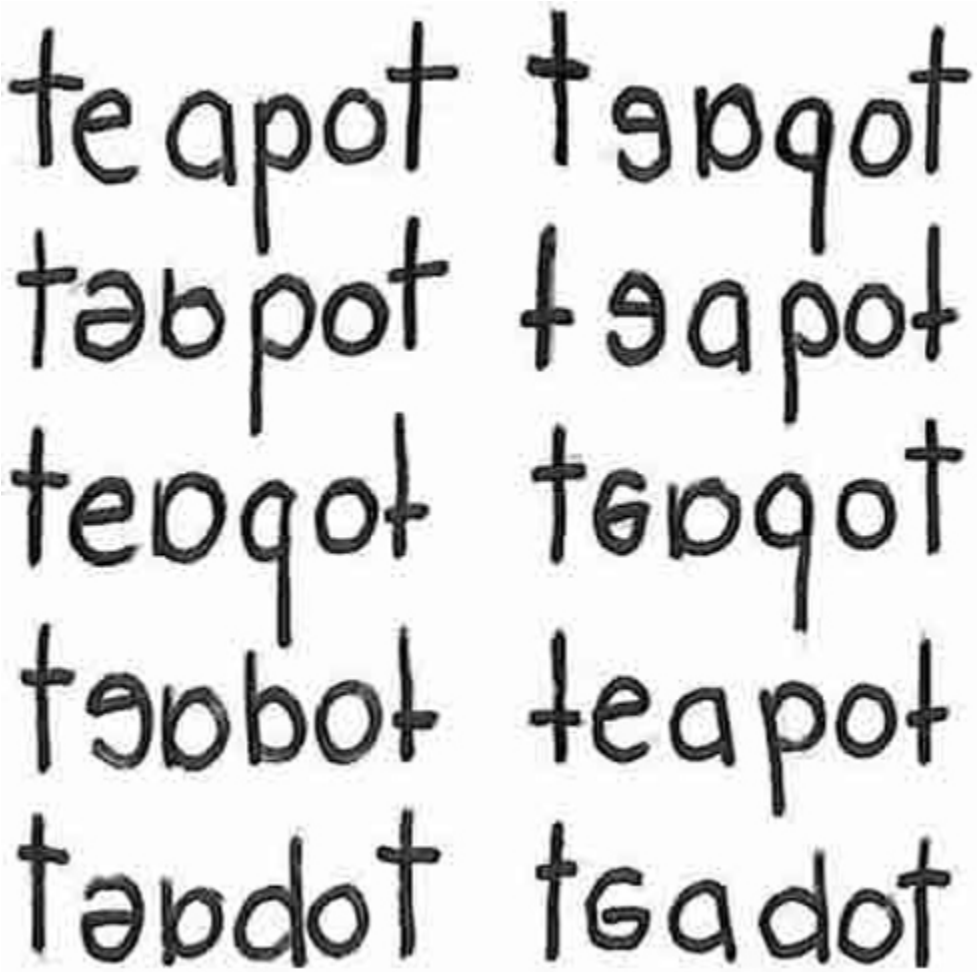
Dysgraphia

Children with **dysgraphia** have a learning disability that results in a struggle to write legibly. The physical task of writing with a pen and paper is extremely challenging for the person. These children often have extreme difficulty putting their thoughts down on paper (Smits-Engelsman & Van Galen, 1997). This difficulty is inconsistent with a person's IQ. That is, based on the child's IQ and/or abilities in other areas, a child with dysgraphia should be able to write, but can't. Children with dysgraphia may also have problems with spatial abilities.

Students with dysgraphia need academic accommodations to help them succeed in school. These accommodations can provide students with alternative assessment opportunities to demonstrate what they know (Barton, 2003). For example, a student with dysgraphia might be permitted to take an oral exam rather than a traditional paper-and-pencil test. Treatment is usually provided by an occupational therapist, although there is some question as to how effective such treatment is (Zwicker, 2005).

Dyslexia

Dyslexia is the most common learning disability in children. An individual with **dyslexia** exhibits an inability to correctly process letters. The neurological mechanism for sound processing does not work properly in someone with dyslexia. As a result, dyslexic children may not understand sound-letter correspondence. A child with dyslexia may mix up letters within words and sentences—letter reversals, such as those shown in [link], are a hallmark of this learning disability—or skip whole words while reading. A dyslexic child may have difficulty spelling words correctly while writing. Because of the disordered way that the brain processes letters and sound, learning to read is a frustrating experience. Some dyslexic individuals cope by memorizing the shapes of most words, but they never actually learn to read (Berninger, 2008).



These written words show variations of the word “teapot” as written by individuals with dyslexia.

Summary

Genetics and environment affect intelligence and the challenges of certain learning disabilities. The intelligence levels of all individuals seem to benefit from rich stimulation in their early environments. Highly intelligent individuals, however, may have a built-in resiliency that allows them to overcome difficult obstacles in their upbringing. Learning disabilities can cause major challenges for children who are learning to read and write. Unlike developmental disabilities, learning disabilities are strictly neurological in nature and are not related to intelligence levels. Students with dyslexia, for example, may have extreme difficulty learning to read, but their intelligence levels are typically average or above average.

Review Questions

Exercise:

Problem: Where does high intelligence come from?

A. genetics
B. environment
C. both A and B
D. neither A nor B

Solution:

C

Exercise:

Problem: Arthur Jensen believed that _____.

A. genetics was solely responsible for intelligence
B. environment was solely responsible for intelligence
C. intelligence level was determined by race
D. IQ tests do not take socioeconomic status into account

Solution:

A

Exercise:

Problem: What is a learning disability?

A. a developmental disorder
B. a neurological disorder
C. an emotional disorder
D. an intellectual disorder

Solution:

B

Exercise:

Problem: Which of the following statements is true?

A. Poverty always affects whether individuals are able to reach their full intellectual potential.
B. An individual's intelligence is determined solely by the intelligence levels of his siblings.
C. The environment in which an individual is raised is the strongest predictor of her future intelligence
D. There are many factors working together to influence an individual's intelligence level.

Solution:

D

Critical Thinking Questions

Exercise:

Problem:

What evidence exists for a genetic component to an individual’s IQ?

Solution:

Twin studies are one strong indication that IQ has a genetic component. Another indication is anecdotal evidence in the form of stories about highly intelligent individuals who come from difficult backgrounds yet still become highly successful adults.

Exercise:

Problem:

Describe the relationship between learning disabilities and intellectual disabilities to intelligence.

Solution:

Learning disabilities are specific neurological problems within the brain and are separate from intelligence. Intellectual disabilities are pervasive and related to intelligence.

Glossary

dysgraphia
: learning disability that causes extreme difficulty in writing legibly

dyslexia
: common learning disability in which letters are not processed properly by the brain

range of reaction

each person’s response to the environment is unique based on his or her genetic make-up